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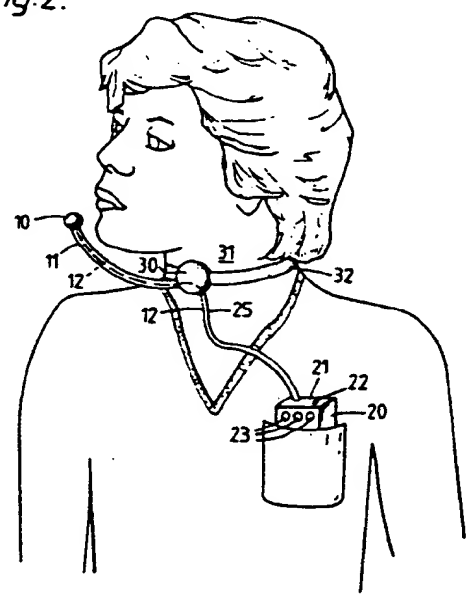
(54) Vocal tactile feedback method and associated apparatus.

(57) A vocal tactile feedback apparatus and method for use in the treatment of stuttering and other speech or hearing abnormalities are disclosed. A microphone (10) and amplifier (20) are utilised to produce and amplify an electronic signal responsive to vocal utterances spoken within a known range of the microphone (10). The amplified signal is then delayed by a suitable delaying circuit for a desired time interval and is then transmitted to an electro-mechanical transducer (30) attached to the outer surface of the laryngeal or glottis region of the neck of a user. The transducer (30) then transforms the amplified delayed signal into a mechanical vibration to provide delayed vibrotactile feedback of the vocal utterances whether spoken by the user or by others. A unique transducer assembly (30) for use in the apparatus and method is disclosed.

Fig.2.



EP 0 226 333 A1

"Vocal tactile feedback method and associated apparatus"

THIS INVENTION relates to a new and improved vocal feedback apparatus and to a method for use in the treatment of stuttering and other speech and hearing abnormalities.

There are many known devices and methods for aiding persons having a speech or hearing problem, such as disclosed, for example, in U.S. Patents Nos. 3,368,551 and 4,310,002.

It is known in speech therapy to provide delayed auditory feedback by means of a headphone. Examples of such delayed feedback are disclosed in U.S. Patent 4,464,119, Pollock et al., "Biomedical Engineering", Vol II, No. 12, Dec. 1976, pp 413-414, and "Stuttering: A full cure", PARADE, Sept. 21, 1980, p.17.

It is known, from French Patent 2,260,133, to provide a switch which permits listening by radio and mastoid bone mediums.

U.S. Patent 4,472,833 discloses a system for providing an indication by various means such as a tactile element when the speech rate exceeds a predetermined value.

U.S. Patent 3,267,931 discloses a feedback system, which, responsive to audio input will provide signals to viable nerves of the facial system.

It has been known in treating certain types of stuttering to measure muscle activity in the lip, chin, larynx and frontalis muscle region and provide an audio signal of a frequency proportional to the level of muscle activity, for example as disclosed in:-Guitar, Journal of Speech and Hearing Research, Vol 18, No. 4, pp 672-685 (Dec. 1975).

It has also been known to record surface electromyograms from the larynx, chin, lip and trapezius. The feedback may be in the form of a tone generated in response to muscle activity. In this regard, reference should be made to:-Hardyck et al., "Feedback of Speech Muscle Activity During Silent Reading: Rapid Extinction", Institute of Human Learning, Univ. of Cal., Berkeley, (August 1967) and Hardyck et al. "Science", Vol. 154, pp. 1467-1468, Dec. 16, 1966.

U.S. Patent 4,198 542 discloses a device which can be used either to increase the amplitude of a person's voice by causing a second vocal cord to vibrate at the same frequency as a first cord, or to aid in closing the glottis by increasing the tension of the crico-thyroid muscle and thereby allowing the thyroid cartilege to swing normally. For each use this device uses a pair of transducers and appropriate amplifiers and rectifiers. While this device does utilize transducers, it would not be suitable for use in providing tactile feedback.

Other devices, such as the one disclosed in U.S. Patent 3,626,607, suggest the concept of tactile stimulation. That device amplifies an instructor's vocal utterance and transmits the same through a mechanical transducer to the hands or feet of the recipient by means of a vibrating panel supported on a platform. It does not, however, provide tactile stimulation of or feedback to the glottis.

U.S. Patent 3,453,749 discloses an apparatus and method for use by a speech therapist or instructor in teaching persons having speech abnormalities. That invention involves the electronic amplification of the instructor's vocal utterance and the direct application of amplified vibrations through a throat transducer to the larynx region of the throat. While that device and method are helpful in the treatment of certain types of speech abnormalities, they do not provide a satisfactory solution to the problem of stuttering.

Stuttering is a spasmodic repetition of a vocal utterance as a result of excitement or some impediment. Typically, stuttering is of psychogenic origin and tends to arise particularly during stress during the pre-school years, but it also occurs when a child starts school or with the onset of puberty. Providing tactile stimulation to the laryngeal or glottis region of the throat does not, in and of itself, provide an effecting treatment for stuttering. Rather, because of its repetitive nature, to provide an effective treatment for stuttering, tactile feedback of the user's own utterance must be delayed in order to allow the user to utilize the tactile stimulation resulting from his own voice rather than that of a third party.

In spite of these known prior art teachings, there remains a real and substantial need for an effective method and apparatus for the treatment of stuttering and other speech and hearing problems.

According to one aspect of the invention, there is provided a vocal tactile feedback method for use in the treatment of speech or hearing abnormalities or otherwise enhancing speech operability comprising the steps of providing a microphone for producing an electronic signal responsive to vocal utterances, providing amplifier means for amplifying said electronic signal, delaying said amplified signal with delaying circuit means for a desired time interval, and providing said delayed signal to an electro-mechanical transducer disposed in contact with an outer surface of the laryngeal region on the neck of a user to provide delayed tactile feedback of the said vocal utterances which may be spoken by the user or by others.

The apparatus may be responsive to vocal utterances spoken by either the user or a third party.

According to another aspect of the invention, there is provided a compact and portable vocal tactile feedback apparatus for use in the treatment of stuttering and other speech abnormalities comprising a microphone for producing an electronic signal responsive to vocal utterances, amplifier means for amplifying said electronic signal, delaying means for delaying said amplified signal for a desired time interval, electro-mechanical transducer means for providing delayed tactile feedback of said vocal utterances, and electrical energising means for said microphone, amplifier means, delaying means and transducer, whereby said apparatus will permit an individual to receive delayed vibrotactile feedback of his or her vocal utterance.

According to yet another aspect of the invention, there is provided transducer apparatus comprising transducer means, coupler means for contact ing the laryngeal region of an individual and transmitting vibrations thereto, and retainer means for receiving at least a portion of said transducer means.

Such a transducer apparatus may readily be provided in a form which will function efficiently in a vocal tactile feedback apparatus embodying the present invention, and may be produced economically.

Embodiments of the invention are described below, by way of example, with reference to the accompanying drawings, in which:-

FIGURE 1 is a schematic view showing the various components of an apparatus embodying the present invention,

FIGURE 2 is a perspective view of another embodiment of the present invention showing a compact and portable delayed tactile vocal feedback device as worn by a user,

FIGURE 3 is an exploded partially schematic view of a transducer assembly,

FIGURE 4 is a top plan view of a form of transducer which may be incorporated in the transducer assembly of Figure 3,

FIGURE 5 is a cross-sectional view of the transducer of Figure 4 taken through the line 5-5 of Figure 4,

FIGURE 6 is a top plan view of a coupler assembly adapted for use with the transducer of Figures 4 and 5,

FIGURE 7 is a cross-sectional illustration of the coupler asembly of Figure 6 taken through the line 7-7 of Figure 6,

FIGURE 8 is a schematic circuit diagram of an embodiment of the present invention,

FIGURE 9 is a schematic illustration of a form of power supply which may be used,

FIGURE 10 is a schematic diagram of a form of variable delay circuit.

Referring specifically to Figure 1, the apparatus shown therein includes a microphone 1 for receiving an audible vocalisation and producing an electric signal responsive thereto, a microphone amplifier 3 for amplifying the signal, a digital delay circuit means and a power amplifier, generally referred to as 5, for delaying the signal and amplifying the same to a sufficient power level so that it may effectively drive an electro-mechanical transducer 7. As there are many types of microphone amplifiers which are known in the art and which will function properly in accordance with the present invention no particular type need be illustrated and described herein. Transducer 7 is utilised to produce a mechanical vibration which is responsive to the vocal utterance received by microphone 1.

Line 2 is provided to operably connect microphone 1 to microphone amplifier 3. Line 4 connects microphone amplifier 3 to the digital delay and power amplifier means 5 and line 6 connects the delay and amplifier means 5 to transducer 7.

An optional set of headphones 9 may also be included for providing, through line 8, simultaneous auditory signals corresponding to the mechanical vibrations which are applied to the laryngeal or glottis region of the back of the user by transducer 7.

Referring now to Figure 2, a portable and compact vocal feedback device embodying the invention is shown. The elements of the device are a microphone 10, an electro-mechanical transducer 30 and a housing 20 containing a microphone amplifier, a delay means, a power amplifier and a suitable power supply such as a battery. The transducer 30 in the form shown is provided so as to contact the surface of the user's neck at or near the glottis or laryngeal region 31 thereof. The transducer is secured in intimate contact by an appropriate elastic or adjustable neck strap 32 or any other suitable securing means, such as a clip or adhesive, for example. Microphone 10 is connected to the transducer 30 by means of microphone support 11 which contains one segment of line 12. The remaining portion of line 12 passes through transducer 30 and is connected to housing 20.

The electrical signal from the microphone is carried by line 12 through the transducer 30 to housing 20 wherein the signal is amplified and delayed. Then the delayed amplified signal is returned through line 25 to the transducer which transforms the amplified signal into responsive mechanical vibration or vibrotactile feedback applied to the user's throat.

Housing 20 may be provided with a number of control means 23 for controlling the amplitude of the amplified signal, the time interval of the delay circuitry and the treble and bass content of the amplified and delayed signal. An on/off switch (not shown) is also provided. Housing 20 is further provided with an output jack 22 which may be utilised for optional headphones to provide additional audio reinforcement.

Housing 20 is preferably formed to have a generally rectangular cross-sectional configuration and is sized so as to conveniently fit in a shirt pocket of the user as shown. Ideally, the housing of this embodiment should be not greater than about four inches high, not greater than about three inches wide and should be as thin as possible, preferably less than about one-half inch.

Referring to Figure 3 in greater detail there is shown a preferred form of transducer assembly. It is desired to provide a relatively shallow transducer assembly, which is electro-mechanically efficient, and relatively light in weight. As is shown in Figure 3, the transducer assembly 50 is, in the form shown, provided with a coupler 52 which facilitates intimate contact between the transducer assembly and the laryngeal region of the user. The transducer 50 is energized through electrical lead 54 - (corresponding in function with the lead 25 in the embodiment of Figure 2) which is connected to a suitable power source.

Referring still to Figure 3 there is shown a preferred form of transducer retainer assembly. A generally tubular retainer 56 is preferably composed of rubber, such as silicone rubber, metal, such as aluminium, or other suitable material. A threaded metal ferrule may be inserted into a rubber retainer, if desired. When the body 58 and end wall 60 are made of metal, flared portion 64 is preferably made of silicone rubber or a similar elastomeric material which is bonded or otherwise secured to tubular body 58. A tubular body segment 58 cooperates with a flared tubular portion 64 and a transverse end wall 60 which has opening 62 to define a recess 63 which receives the transducer assembly 50. A strap 70 which is adapted to be in intimate engagement with the user's neck is secured to ears 66, 68 of retainer 56. An external thread 74 on transducer assembly 50 is threadedly engaged by an internal thread 76 on retainer 56. When the desired relative position (generally with wall 72 facing wall 60) is achieved, lock screw 78 is tightened to secure the transducer assembly 50 to the retainer 56. The retainer 56 and transducer assembly 50 should be in such relative position that contact between the vibrating element and the laryngeal region will be maintained as the vibrotactile motion occurs, while resisting excessive deflection.

Either by use of an elastic strap 70 or an adjustable length strap 70 or by other means, such as by an adhesive or clip, the transducer assembly 50 is maintained in intimate contact with the user. Projecting flared portion 64 serves to facilitate maintaining the desired intimate contact between the transducer assembly 50 and the laryngeal region of the user's neck. The flared portion is preferably in resiliently maintained, annularly continuous contact with the user.

Referring to Figures 4 and 5, there is illustrated a preferred form of transducer 90 which has a magnetic core 91 and transducer container 92, both of which are disposed within transducer assembly 50 and are separated by coil receiving gap 99. Container 92 has a bottom wall 94, an annular side wall 92 and an annular top wall 98. A preferred magnetic material for the transducer is one which is composed of rare earth magnetic materials. Specifically preferred magnetic materials would be those composed of samarium-cobalt or neodymium-iron-boron. It is preferred that the transducer be fabricated with relatively thin magnetic assemblies of high flux densities and that they be relatively light in weight. It is preferred that the transducer assembly employ an open spider type suspension in order to efficiently produce the desired tactile vibrations. The suspension should support the voice coil in proper alignment and minimise the undesired production of sound by vibrating elements. The voice coil is received in gap 99. This may function similarly to a voice-coil/magnet system such as is used in a high efficiency loudspeaker. The retainer 56 also serves to resist undesired entry of external sound. The transducer may be of any other suitable type such as piezoelectric, for example.

It is preferred that the transducer assembly 90 has a coupler such as 52 in Figure 3 interposed between the transducer and the user in order to enhance intimacy of contact and transmission of the tactile action. Referring to Figures 6 and 7 there is shown a preferred form of coupler. A preferred approach is to provide a deformable layer of vibration transmitting material between the transducer and the user's laryngeal region. A suitable material for this purpose is borosiloxane. Such a material will flow under steady state stresses to establish the desired intimacy of contact between the transducer and the user, while being highly elastic in response to suddenly applied stresses. As a result when the assembly is placed in contact with the user the material will deform to establish intimate surface to surface contact between the material and the user. Tactile excitation will result from transducer vibrations passing through the material with little loss.

In the form shown in Figures 6 and 7, the vibration transmitting material is contrained within a plurality of closed cells 102 which face the user.

A substantially rigid coupler 108 which may be composed of foamed polystyrene, for example, is interposed between cells 102 and open spider which has domed centre 114 which may preferably be composed of a non-ferrous metal, such as aluminium, and periphery 110. The coupler 108 preferably has exteriorly concave surfaces. Voice coil 112 is mounted on an annular member and is adapted to be disposed in the gap 99 of transducer 90.

It is to be understood that various other forms of the present invention are contemplated. For example, a microphone could easily be formed integrally with the transducer thereby eliminating the need for a separate microphone. Additionally, a small transmitter and receiver could be incorporated into the transducer making it fully integrated and operational without the need for any connecting wires.

As will be appreciated from the foregoing, the underlying idea of the apparatus and method of the invention is to provide delayed tactile feedback of the utterances. An advantage of the system described with reference to the drawings is that this allows the user to provide the vocal utterance thereby eliminating the need to have an instructor or third party involved in the process. This system, therefore, provides a self-instructional device wherein a person responds to input from himself or herself or from a third party.

In the treatment of stuttering, a delay of about 250 milliseconds between the making of an utterance and the feedback of the same is preferably employed initially with the amount of the delay being reduced as treatment progresses. An infinitely variable time delay circuitry is preferred in the apparatus for maximum flexibility.

While it will be readily apparent to those skilled in the art that numerous forms of electrical circuits, delay means and power sources may be employed in carrying out the present invention a specific preferred form will be disclosed herein.

As is shown in Figure 8, a signal from microphone 130 which may be a low impedance dynamic type, passes by leads 132 to an amplifier 134 which may have a gain of about 16. Depending upon the position of filter select switch 160 the signal emerging from amplifier 134 on lead 150 will pass through one of the low pass filters 140, 142, 144. If desired, a single low pass filter could be employed in lieu of filters 140, 142, 144 with switch 160 being eliminated. These filters may, for example, respectively, have cut off frequencies of 2 KHz, 3 KHz and 4 KHz. These filters limit the high frequencies going to the delay circuit. The signal then passes to an equaliser 162 which may be a 12 band equaliser and passes from equaliser 162 by leads 166, 174 to variable audio delay circuit 170 which has a delay adjustment facility 172. The equaliser 162 may be employed to emphasise or de-emphasise selected frequency bands of the user's voice. It also may be employed to reduce acoustic feedback between the microphone and vibration transducer.

The delay circuit may be set to the desired delay period by adjustment means 172. The delay circuit will cause the signal from the microphone to be delayed in reaching the vibration transducer, preferably by up to about 0.5 seconds for example. In treating stuttering, a delay period of about 250 milliseconds, for example, might be employed. When a switch 181 is in the "on" position shown, the signal from the delay circuit 170 will pass through low pass glitch filter 186 over lead 190 to gain adjust circuit 196 which controls the amount of signal reaching bridge power amplifier 202. Signals emerging from gain adjust circuit 196 pass over lead 200 to bridge power amplifier 202 which has floating outputs and is used to energise transducer 206. Amplifier 202 output is carried by lead 204 to the vibration transducer 206 which converts the electrical signal to vibrotactile motion vibrations. The low pass glitch filter 186 may be a 4th order low pass filter with a cut off frequency of 4 KHz, for example. This filter 186 eliminates any clock frequency component from the delay circuit 170 that may be mixed with the audio signal. In the "off" position of switch 181, the signal from equaliser 178 passes along a bypass line 178 directly to filter 186, so that in this case tactile feedback is not delayed.

In one position of a select switch 180 the signal on line 188 from glitch filter 186 will pass to a spectrum analyser 184. In another position of switch 180, the feedback signal from a transducer sensor 207, provided on lead 208 will enter spectrum analyser 184. The spectrum analyser 184, in said one position of switch 180, serves to indicate the spectral content of the electrical signal applied to the transducer. Alternately, with the switch 180 in its other position, the analyser can indicate the spectral content of the tactile vibrations applied to the patient's throat when the transducer is supplied with a standardised signal. In this mode of operation, the analyser 184 is supplied, on a line 208, with a signal from an amplitude sensor such as a strain gauge sensor mounted on the transducer, for example, and a "pink noise" generator can be advantageously connected at the input system in lieu of the microphone, to provide the standardised signal. Reference herein to use a microphone shall

be deemed to embrace such a practice. The analyser will then yield a direct measure of the amplitude response of the system with uniform energy excitation over the selected frequency band.

The form of circuit shown in Figure 8 is best suited to use in vocal feedback apparatus for clinical application. For compact, battery powered units, such as that shown in Figures 1 and 2, there will not normally be provided an equaliser, a spectrum analyser or adjustable low pass filters as the omission of these minimises size, weight and power requirements.

Figure 9 illustrates a suitable power supply 210 for use in the circuit of Figure 8. The supply has 110 volt AC input and output terminals at +9 volts, -9 volts, +12 volts, -12 volts and ground. This power supply may be employed for all components except the bridge power amplifier 202 which uses +12 volts DC. Alternately, one or more batteries of suitable voltage may be employed.

Referring to Figure 10, details of a form of delay circuit will be considered employing certain new reference numbers for convenience of reference. The variable time delay circuit shown enables an analog time delay which is preferably adjustable continuously over the range 0.03 -0.05 sec. A signal from equaliser 152 is introduced into analog delay line 220 by leads 166, 218. The clock frequency is provided by a multivibrator 224 with an adjustable frequency established by adjustment means 226. Lead 228 is at the desired predetermined voltage. Lead 222 connects clock input of analog delay line 220 with multivibrator 224. Lead 240 carries the signal from delay line 220 to low pass filter 242 having feedback components 244, 246. A standard RD 5108 delay line may be used. If desired, additional stages can be added to improve the accuracy of the delayed output at high frequencies. Thus, the sampling rate can be doubled by adding a second series delay line improving the resolution of the delayed output, particularly at maximum delay. The "glitch" filter shown in the block diagram serves to smooth the output of the delayed signal. Shorter delays are possible by increasing the clock frequency (zero delay can be obtained by simply bypassing the delay circuit by placing switch 181 in the "off" position, so connecting the output from equaliser 167 directly to the glitch filter).

The bias network connected to lead 218 and delay line 220 shown in the diagram ensures that the input remains positive (the delay line should ideally work between about 5 and 9 v).

It is contemplated that the present invention may also be useful in the treatment of deaf children. It is envisioned that by providing a portable unit with a compact tactile feedback device on a child's throat, to be worn on a semi-permanent basis, the "babble behaviour" feedback which all young children receive from their parents may be enhanced. As infants grow, many hours are spent by parents in communicating to their children. If tactile stimulation of the glottis or laryngeal region of the child's throat is provided each time the parent communicates verbally with the child, it is believed that the constant external tactile stimulation and the child's self-generated tactile stimulation may prove to be useful in later stages of learning to speak. As the child grows older the device may then be utilised with the delay circuitry so that the child, without the aid of a therapist or teacher, may practice various vocalisation skills and then receive subsequent tactile feedback of such vocalisations.

It will be appreciated that a device embodying the invention may be made relatively small and unobtrusive and that throat and/or lavalier microphones may readily be used. This provides psychological benefits in reducing anxiety in stress-inducing situations requiring speech. This is of particular importance to stutterers. The device may easily be used for prolonged periods of time in a wide variety of environments.

It will be appreciated that the present invention by employing tactile feedback, as distinguished from solely auditory feedback is based upon different neurological systems and phenomena in different parts of the body.

While for clarity of disclosure a particular form of microphone has been illustrated, it will be appreciated that numerous types of microphones may be employed in the present invention. A throat microphone, for example, may be employed advantageously, if desired.

As explained above, the present invention provides for a delayed signal responsive to a vocal utterance to be supplied to an electro-mechanical transducer which is secured in intimate contact with an outer surface of the laryngeal region of the neck of the user in order to produce delayed tactile feedback of the utterance.

The method and associated apparatus embodying the invention can enhance the awareness in the user of his or her own and other's vocalisations and phonatory behaviour.

It is possible to provide heightened user awareness by accentuating normal vibratory sensations produced by the larynx by applying delayed and amplified speech signals to the laryngeal region by the external electro-mechanical transducer.

The method and apparatus of the invention can be used for inducing the sensations of normal speech to persons having reduced functionality of the vocal cords or a hearing problem.

Whereas particular embodiments of the invention have been described above for purposes of illustration, it will be appreciated by those skilled in the art that numerous variations of the details may be made without departing from the invention as described in the appended claims.

The features disclosed in the foregoing description, in the following claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Claims

1. A vocal tactile feedback method for use in the treatment of speech or hearing abnormalities or otherwise enhancing speech operability comprising the steps of providing a microphone for producing an electronic signal responsive to vocal utterances, providing amplifier means for amplifying said electronic signal, delaying said amplified signal with delaying circuit means for a desired time interval, and providing said delayed signal to an electro-mechanical transducer disposed in contact with an outer surface of the laryngeal region on the neck of a user to provide delayed tactile feedback of the said vocal utterances which may be spoken by the user or by others.

2. A compact and portable vocal tactile feedback apparatus for use in the treatment of stuttering and other speech abnormalities comprising a microphone for producing an electronic signal responsive to vocal utterances, amplifier means for amplifying said electronic signal, delaying means for delaying said amplified signal for a desired time interval, electro-mechanical transducer means for providing delayed tactile feedback of said vocal utterances, and electrical energising means for said microphone, amplifier means, delaying means and transducer, whereby said apparatus will permit an individual to receive delayed vibrotactile feedback of his or her vocal utterance.

3. A vocal tactile feedback apparatus according to claim 2 wherein said delaying means is infinitely variable.

4. A vocal tactile feedback apparatus according to claim 2 wherein said energizing means is a battery, and said battery, amplifier means and delaying means are provided in a readily compact and portable housing.

5. A vocal tactile feedback apparatus according to claim 2 wherein said electro-mechanical transducer means is readily adapted to be placed in contact with the laryngeal region of the user's neck.

6. A vocal tactile feedback apparatus according to claim 5 wherein said transducer means includes a transducer, and coupler means are disposed adjacent to said transducer.

7. Transducer apparatus comprising transducer means, coupler means for contacting the laryngeal region of an individual and transmitting vibrations thereto, and retainer means for receiving at least a portion of said transducer means.

8. Apparatus according to claim 6 or claim 7 wherein said coupling means includes a deformable vibration transmitting material for facilitating intimate contact between said transducer apparatus and said user, and a substantially rigid vibration-transmitting material interposed between said deformable material and said transducer means.

9. Apparatus according to claim 8 wherein said retainer means includes a tubular body portion, a flared end portion at one end of said body and an end wall at the other end of said body, said flared portion being adapted to contact said user and stabilise the position of said transducer means with respect to said user.

10. Apparatus according to any of claims 7 to 9 wherein said transducer means is threadedly secured to said retainer means.

11. Apparatus according to claim 10 including locking means for securing said transducer means in desired relative position with respect to said retainer means.

12. Apparatus according to any of claims 7 to 11 wherein said transducer means is at least partially received within said retainer means.

Fig.1.

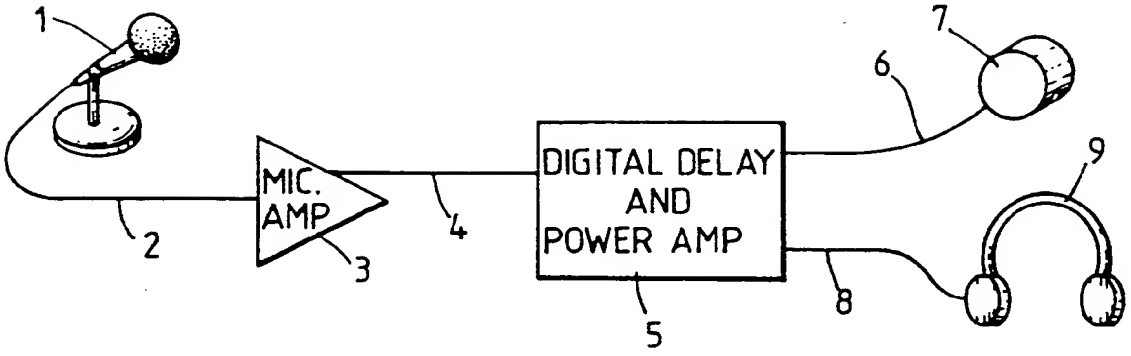
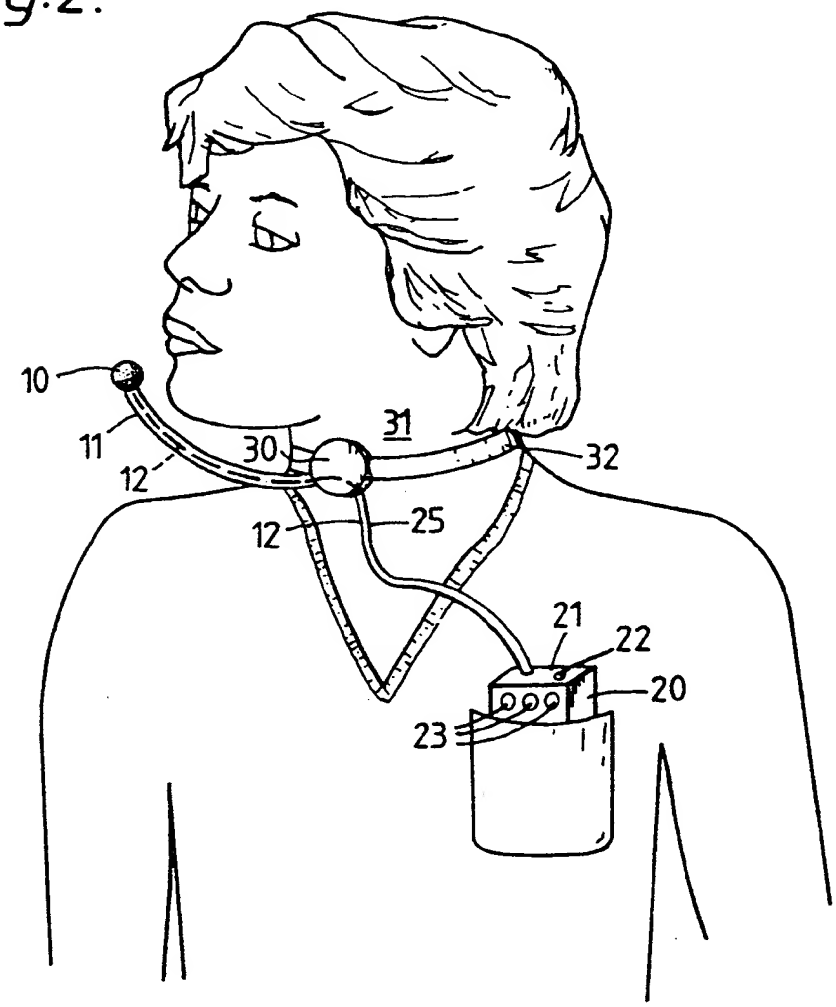


Fig.2.



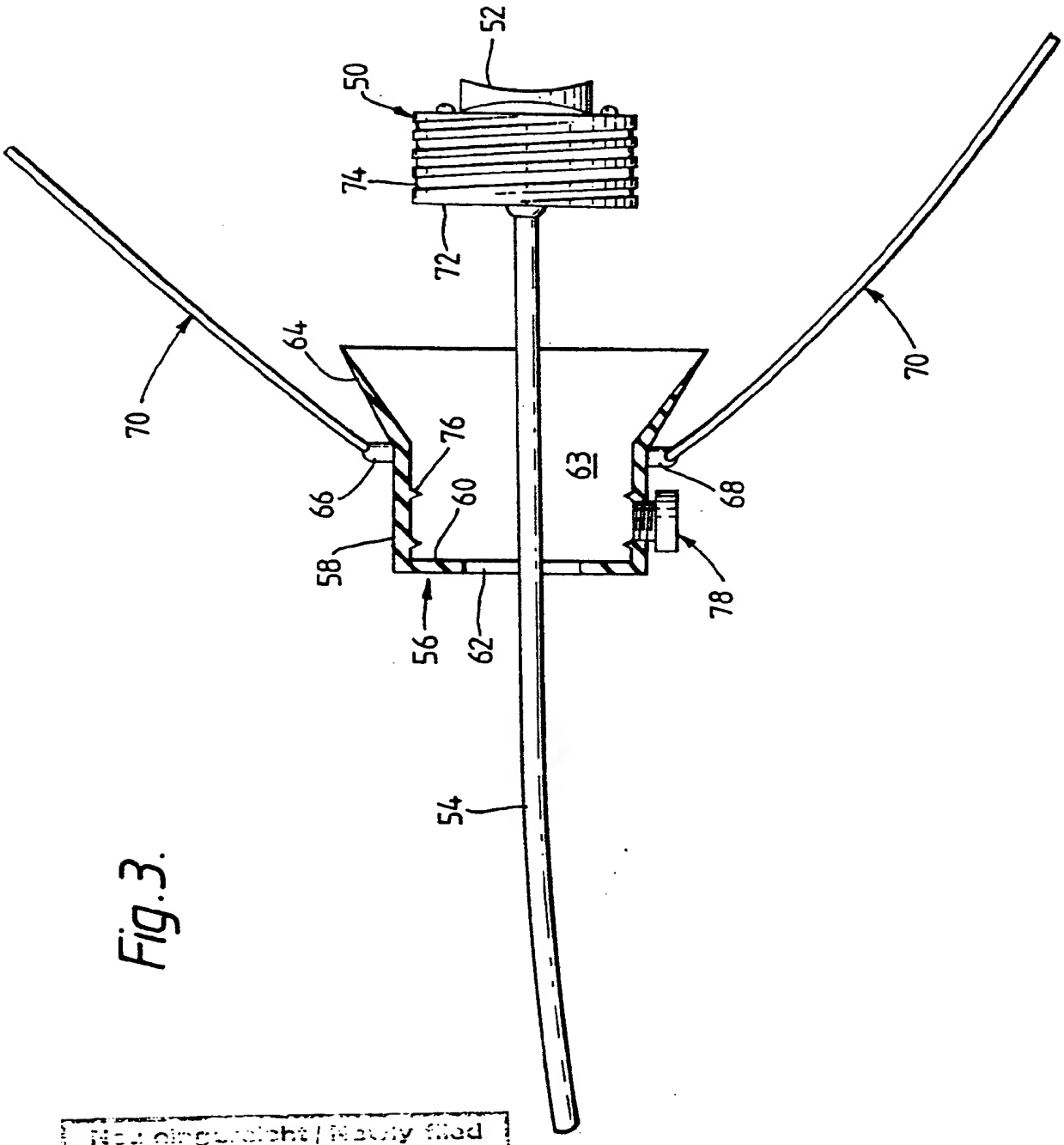


Fig.3.

Fig.4.

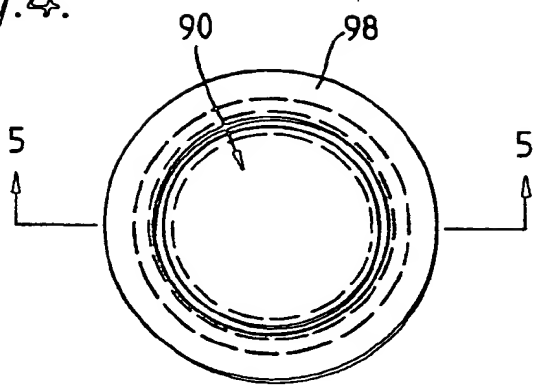


Fig.5.

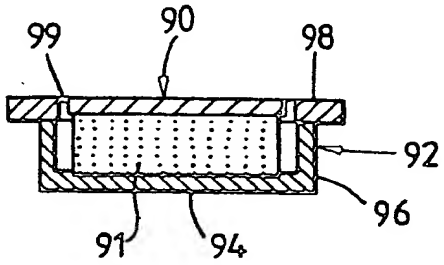


Fig.6

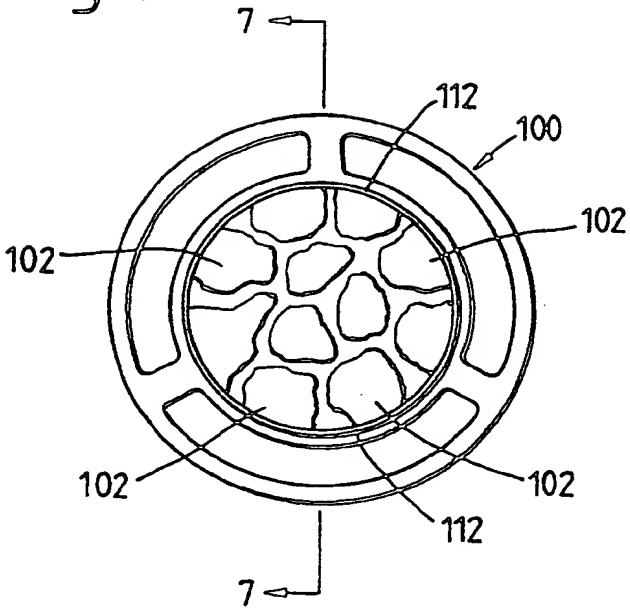
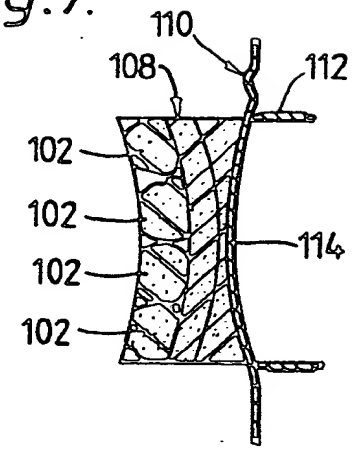


Fig.7.



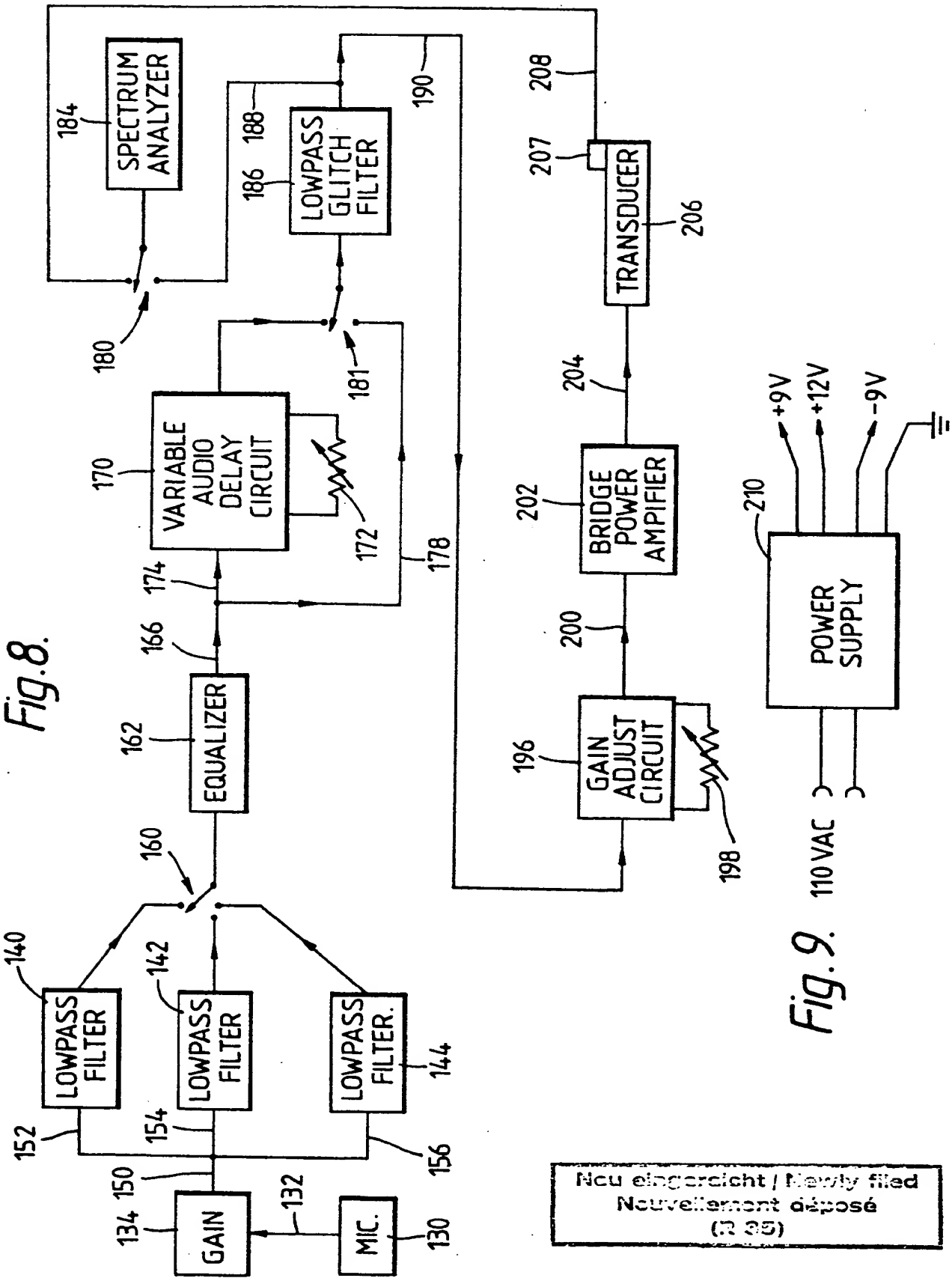


Fig.8.

Fig.9.

Neu eingereicht / Newly filed
Nouvellement déposé
(R 35)

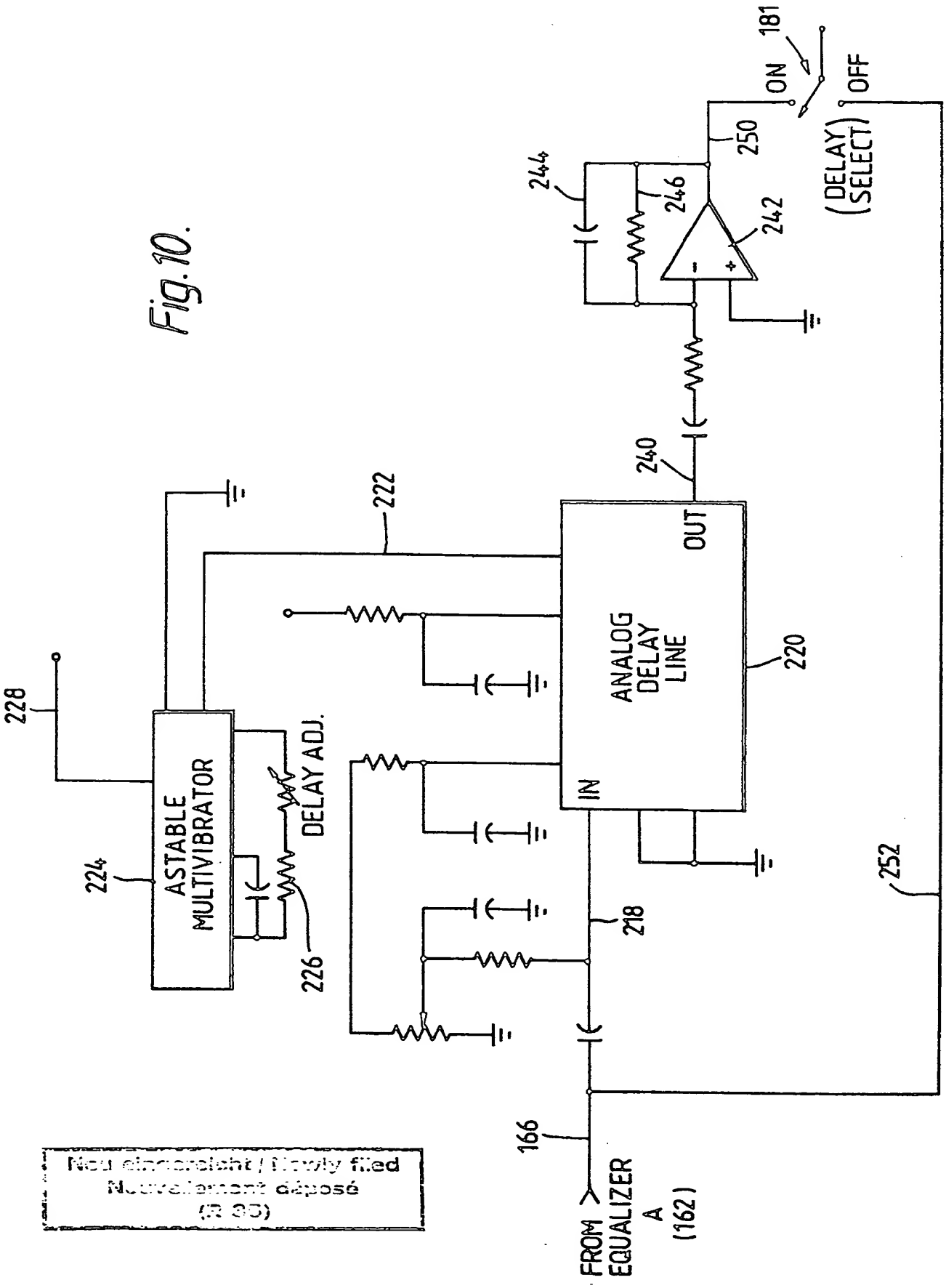


Fig. 10.

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 86308830.8

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl 4)
Y	DE - A1 - 3 100 135 (TOMATIS) * Totality * --	1,2	A 61 F 11/04 H 04 R 25/00 G 09 B 21/00
Y	DE - B2 - 2 038 292 (ZCM CORP) * Totality * --	1,2	
Y	DE - A1 - 3 208 678 (SIEMENS) * Totality * --	1,2,7	
Y	DE - B - 2 316 708 (SZM LTD) * Totality * --	1,2,7	
D,Y	US - A - 3 626 607 (SCHWAKE) * Totality * --	1,2,7	
Y	CH - A5 - 630 252 (WALKER) * Totality * --	1,2,7	
D,A	US - A - 3 453 749 (SNEDEKER) * Totality * --	1,2	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

A 61 F 11/04
H 04 R 25/00
G 09 B 21/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	05-02-1987	HÜTTNER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EUROPEAN SEARCH REPORT

Application number

EP 86308830.8

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
D,A	BIOMEDICAL INGINEERING, vol. 11, no. 12, December 12, 1976, London, United Trade Press Lim. POLLOK GREGORY SHAW, "A solid state delayed auditory feedback system for speech Therapy" pages 413-414 --		
D,A	JOURNAL OF SPEECH AND HEARING RESEARCH, vol. 18, no. 1, March 1, 1975 THE AMERICAN SPEECH AND HEARING ASSOCIATION GUITAR "Reduction of stuttering frequency using analog electromyographic feedback" pages 672-685 --		
D,A	SCIENCE, vol. 154, no. 3755, December 16, 1966 AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SIENCE HARDYCK PETRINOVICH ELLSWORTH "Feedback of Speech muscle activity during silent" pages 1467-1468 ----		TECHNICAL FIELDS SEARCHED (Int. Cl.4)

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